

Simulated Lunar Testing of Metabolic heat regenerated Temperature Swing Adsorption Technology

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Metabolic heat regenerated Temperature Swing Adsorption (MTSA) technology is being developed for thermal and carbon dioxide (CO₂) control for a Portable Life Support System (PLSS), as well as water recycling. An Engineering Development Unit (EDU) of the MTSA subassembly was designed and assembled for optimized Martian operations, but also meets system requirements for lunar operations. For lunar operations the MTSA sorption cycle is driven via a vacuum swing between suit ventilation loop pressure and lunar vacuum. The focus of this effort is operations and testing in a simulated lunar environment. This environment was simulated in Paragon's EHF vacuum chamber. The objective of this testing was to evaluate the full cycle performance of the MTSA Subassembly EDU, and to assess CO₂ loading and pressure drop of the wash coated aluminum reticulated foam sorbent bed. The lunar testing proved out the feasibility of pure vacuum swing operation, making MTSA a technology that can be tested and used on the Moon prior to going to Mars. Testing demonstrated better than expected CO₂ loading on the sorbent and nearly replicates the equilibrium data from the sorbent manufacturer. This had not been achieved in any of the previous sorbent loading tests performed by Paragon. Subsequently, the increased performance of the sorbent bed design indicates future designs will require less mass and volume than the current EDU rendering MTSA as very competitive for Martian PLSS applications.